**Board of Forestry and Fire Protection**

**Threatened or Impaired Watershed Regulatory Scientific Literature Review**

**Key Questions**

(Composite of Forest Practice Committee participants as of July 14, 2006
Note: does not include CDF Forest Practice of Board member Ostrowski information)

## A. Salmonid life-cycle needs

1. What water flow, quality (e.g., temperature, turbidity) and aquatic habitat (e.g., gravel size distribution, riffle and pool structure and depth) conditions are needed at each life stage (e.g., spawning, incubation, rearing, and migration) for population viability of each salmonid species and for their aquatic food organisms? Are there any consistent thresholds separating conditions that are optimal from those that are sub-optimal but sufficient to maintain population viability and from those that are insufficient?
2. What are the critical times of year for each life stage for each species?
3. What is the relative importance of each of these needs? Which are the more common and/or significant limiting factor(s) for salmonid populations?

## B. Near-stream/riparian/floodplain beneficial functions

1. What are the beneficial functions of near-stream/riparian/floodprone areas (e.g., filtering sediment and other pollutants from entering streams, stabilizing stream banks, attenuating peak flows, minimizing channel migration; providing large woody debris, providing nutrients and food organisms, stabilizing air and water temperatures) in providing/maintaining the life-cycle needs of salmonid species either directly or indirectly though food organisms.
2. What characteristics of these areas (e.g., organic litter and debris, canopy structure and composition, bank armoring, imbedded large wood debris) improve or diminish each of these functions? In what manner and to what degree?
3. In what manner and to what degree have various types of near-stream timber operations or riparian management practices been shown to either increase or diminish each of these beneficial functions and/or the related characteristics? To what degree are they sensitive to disturbance by timber operations?

## C. Near-stream and floodprone area hazards

1. What are the potential natural hazards associated with near-stream and floodprone areas (e.g., bank instability, lateral and vertical channel migration, flow obstruction or diversion of flow)?
    a. What characteristics of near-stream and floodprone areas increase or decrease each of these potential hazards? In what way and to what degree?
    b. What is the relative importance of each potential hazard to anadromous salmonids at each life stage, either directly or indirectly?

2. In what manner and to what degree have various types of near-stream/floodprone area timber operations or riparian management practices been shown to either increase or diminish each near-steam hazard and its effects on the life-cycle needs of salmonids?

**D. Hillslope geologic hazards which could have deleterious effects on riparian buffer zones and anadromous salmonid populations**

1. What are the potential natural geologic hazards (e.g., mass wasting or accelerated erosion) associated with hillslopes outside the near-stream area?
2. What natural conditions make hillslopes prone to mass wasting and high erosion rates (e.g., slope, soil texture and composition, groundwater) if disturbed by timber operations?
3. In what manner and to what degree have geologic hazards triggered by hillslope timber operations been shown to harm (or harm the recovery of) salmonid populations either directly or indirectly? What varieties of hillslope timber operations (e.g., road construction, road drainage) are associated with each geologic hazard, and what is the strength of the association? What types of hillslope timber operations have been shown to diminish such geologic hazards?
4. What types of negative effects can the hillslope geologic hazards have on the beneficial functions of nearstream areas; how can they exacerbate near-stream hazards?
5. In what manner and to what degree have various types of near-stream timber operations or riparian management practices been shown to either increase or diminish the negative effects of each hillslope geologic hazard?
    a. What are the types of mass wasting or erosion events for which riparian buffer zones are not effective in preventing or reducing discharges of sediment or large woody debris into fish-bearing waters (e.g., debris torrents, gully flow and erosion) and those for which they are relatively effective (e.g., sheet and rill erosion)?
    b. What riparian buffer zone characteristics are most strongly associated with its effectiveness (or lack thereof) in minimizing discharges from hillslope hazards?
6. What is the relative contribution of hillslope geologic hazards to sediment and large woody debris discharges compared to nearstream areas?

**E. Direct inputs from timber operations**

1. In what manner and to what degree have discharges of petrochemicals, pesticides, fertilizers from timber operations been shown to harm (or harm the recovery of) salmonid populations either directly or indirectly?
2. What is the relationship between concentration of/exposure to any such pollutant and the type and degree of direct or indirect harm to salmonids?

## F. Nutrients

Nutrients can be supplied to the stream channel through leaf litter fall.

1. Does leaf litter fall from riparian habitats have any bearing on the nutrient levels with stream zones?
2. At what distance(s) from the stream channel are nutrients supplied from leaf litter fall?
3. Does thinning within the WLPZ cause changes in the forest composition between conifers and deciduous hardwoods which then result in changes in the yearly pattern of litter fall?

## G. Root Strength

Root Strength by streamside trees can provide stream bank stability necessary for channel stabilization.

1. What is the contribution of roots to stream channel stability in different types of channels and watersheds?
2. At what distances(s) from the stream channel does root strength from streamside trees provide stream bank stabilization?
3. Does the type (conifer or hardwood) or species of trees influence this relationship?
4. How does harvesting impact the root strength contribution to channel stability?

## H. Vegetative Shade

What is the effect of shade-producing canopy on a specific stream's water temperature regime?

1. If shade-producing canopy has an effect, at what distances from the stream channel is shade-producing canopy effective?
2. What reductions in the shade-producing canopy are possible before significant effects occur?
3. Are the different vegetative shade measurement devices comparable and are any differences important in predicting potential changes in water temperature due to harvest?

## I. Coarse Woody Debris/ Wood Loading

Coarse Woody Debris is recruited from vegetation and contributes to complex fish habitats.

1. What are the primary ecological process(s) that result in the recruitment of coarse woody debris into stream channels?
2. From each of these ecological process(s), at what distances is coarse woody debris recruited?
3. Can forest management activities impact natural wood recruitment processes?
4. Can the quality of large woody debris be artificially enhanced by forest management activities?
5. Is wood loading in streams associated with salmonid production?

6. Is there a relationship between wood loading and adjacent riparian composition and structure?
7. What portions and size of wood loads affect channel morphology?

## J. Microclimates

Microclimates created by streamside vegetation, in addition to solar radiation, influence ambient air temperature, relative humidity, and wind speed which effect stream water temperature regimes.

1. What is the relationship between measurable riparian microclimate air temperatures, relative humidity and wind speed and stream water temperatures?
2. Do changes in microclimate air temperatures, relative humidity and wind speed impact, positively or negatively, the overall stream water temperature budget?
3. At what distance from the stream channel does microclimate impact, positively or negatively, stream water temperatures?

## K. Sediment

Sediment from overland flow can be filtered by riparian and upland habitat vegetation.

1. What are the primary types of overland flow sedimentation?
2. What kinds of potential disturbances can be associated with these primary types?
3. At what distance to the stream channel do riparian habitats ameliorate sediment flow to the stream channel?
4. How does the overall percentage of stream sedimentation from overland flow vary with watershed characteristics?
5. What types of forest management activities impact different types of overland flow sediment sources?
6. What regulations exist to ameliorate sediment production in streamside zones and are they effective?

## L. Natural Variability

Natural Variability from watershed to watershed is typically due to a watersheds unique physical condition (i.e. space) and unique history of natural disturbances (i.e. time). The physical condition of a watershed can vary due to, but not limited to; geology, climate, precipitation patterns and resulting vegetation types. The natural disturbance history is our attempt to measure time, but in fact the watershed or stream channel is in constant change over time and review of scientific information should be aware of this variability.

## M. Stochastic Events

In addition to understanding the six ecological features and natural variability, it is also important to assess other more stochastic natural events. Riparian habitats are typically changed by natural disturbances such as fire, flooding, and windthrow. Stream channels can be changed by disturbances such as landslides, lateral channel erosion, peak flow flooding, and deposition of debris during peak flows. All of these disturbances help create a highly diverse riparian plant communities and complex stream channel habitats (*Gregory et al. 1991*). Accordingly, uncertainty caused by stochastic events requires that riparian habitats and stream channel protection measures be reviewed and assessed on a site-by-site basis as described in the Forest Practice Rules.